

# Research on Human Exposure to Pesticides

Edward J. Kasner, PhD, MPH

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**W ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES**  
UNIVERSITY of WASHINGTON | SCHOOL OF PUBLIC HEALTH

# Overview

1. Pesticide Exposure Pathways: Forestry Applications
2. Drift Exposure Assessment Study Design
3. Previous Studies
4. Herbicide Health Considerations

# Pesticide Exposure Pathways: Forestry Applications

## 1. Source

- ▶ Aerial application: helicopter, airplane
- ▶ Bark injection: hack/squirt
- ▶ Backpack spraying: spots/strips by young trees

## 2. Medium

- ▶ Air
- ▶ Water
- ▶ Soil

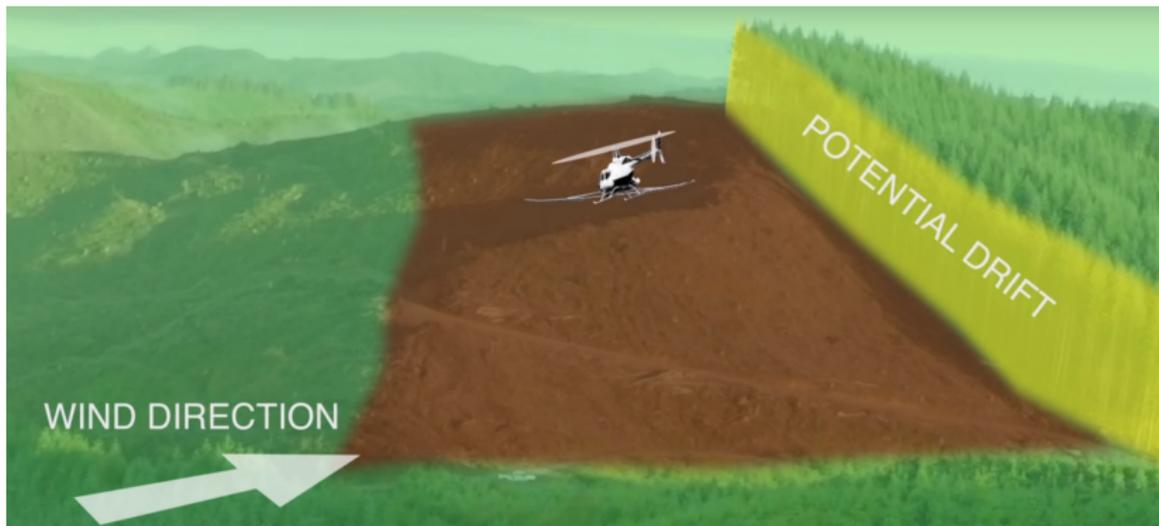
## 3. Route of Exposure

- ▶ Dermal
- ▶ Inhalation
- ▶ Ingestion

## 4. Receptor

- ▶ Handler: mix, load, or apply
- ▶ Worker: in/near treated area during/after spray
- ▶ Bystander: outside treated area (drift, take-home, watershed)

# Pesticide Exposure Pathways: Forestry Applications



Credit: Pesticides in Forestry, A Workers' Guide to Safe Practices. Oregon Department of Agriculture, Oregon OSHA, and US EPA Region 10.

# Previous Pesticide Exposure Studies

## 1. Non-drift studies

- ▶ Dermal: patch, handwash, wipe
- ▶ Inhalation: air pump + filter
- ▶ Ingestion: duplicate diet
- ▶ Biological monitoring: urine samples

## 2. Drift studies

- ▶ Field sampling: ASABE S561.1 or ISO 22866 protocols
  - ▶ Orchard-based studies (sprayer technology)
- ▶ Mechanistic modeling: exposure not measured directly
  - ▶ US Forest Service: AgDISP
  - ▶ UK Silsoe Spray Applications Unit
- ▶ Incident tracking: exposure estimated after-the-fact
- ▶ Proximity: pesticide use and health outcomes
- ▶ WA Aerial Spray Drift Study
  - ▶ Measure and model spray event
  - ▶ Measure community air and surface levels
  - ▶ Measure and model children's activities and exposures

# Drift Exposure Assessment Study Design

1. Passive field sampling
  - ▶ Cards: deposition in horizontal plane, gravitational settling
  - ▶ Strings: airborne in vertical plane, interception
2. Active field sampling
  - ▶ Air pumps and filters
  - ▶ Real-time instruments
3. Factors during application
  - ▶ Meteorology (wind direction)
  - ▶ Application method
  - ▶ Droplet size (nozzles)
  - ▶ Canopy structure
  - ▶ Technology (electrostatic spot-spraying drones?)
4. Factors after application
  - ▶ Volatilization
  - ▶ Resuspension

# Deposition and Airborne Sampling

Low-density  
polyethylene

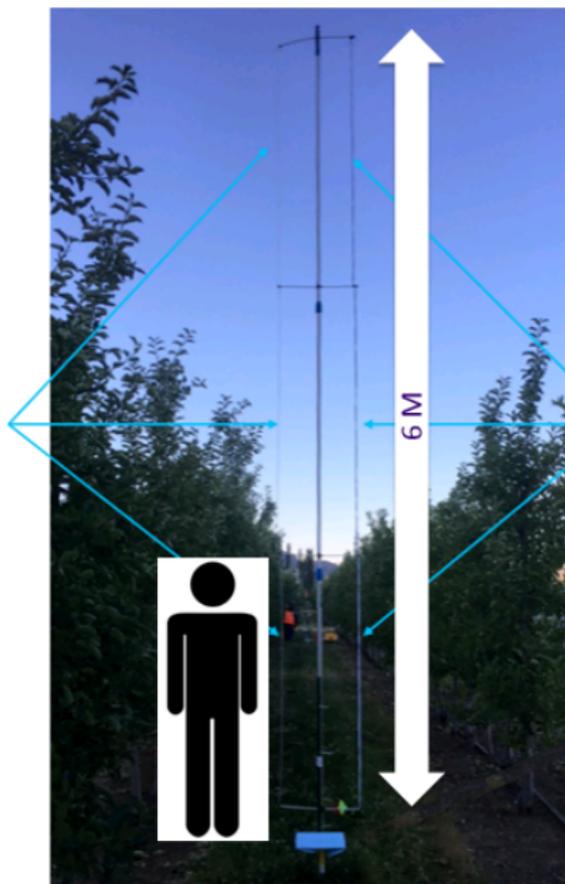
“LDPE line”

- Three 2 m lengths
- 4 mm diameter

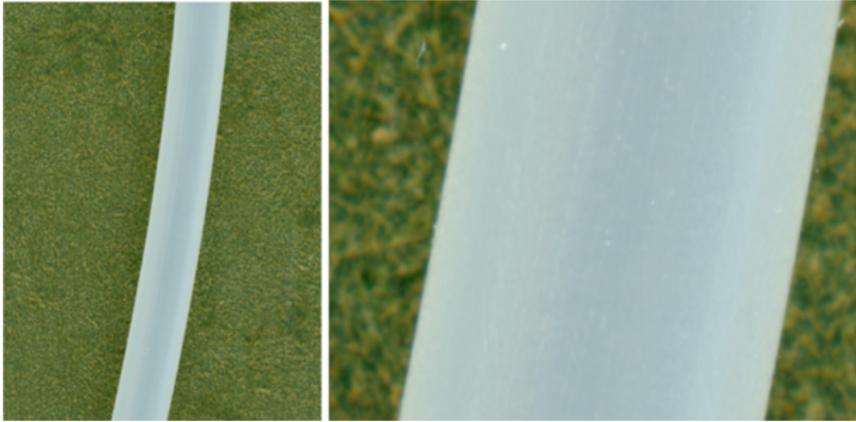
Polyester with  
cotton core

“PE line”

- Three 2 m lengths
- 12 mm diameter



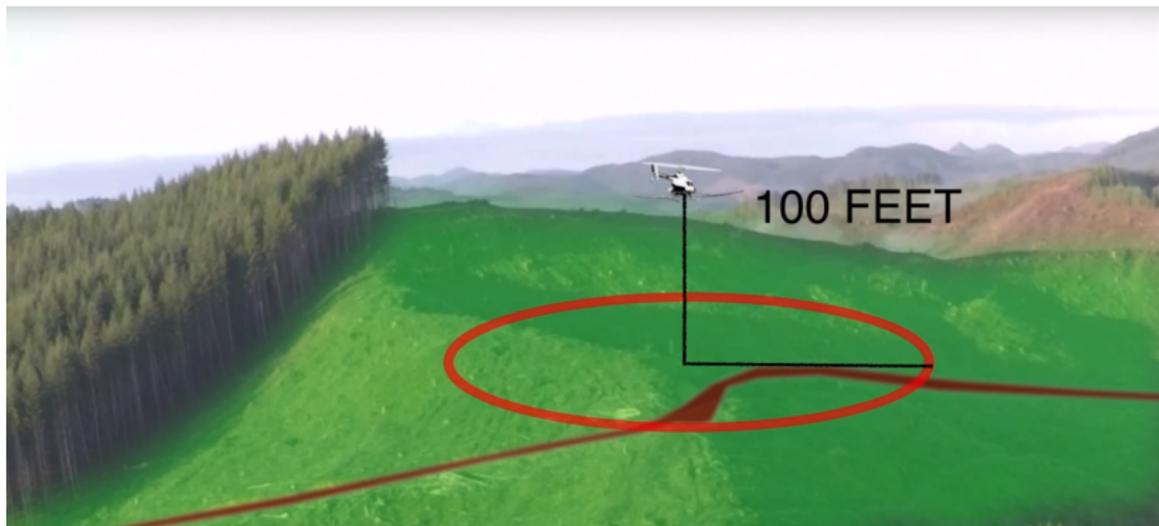
# Vertical String Matrices



# Low Cost Real-time Monitors

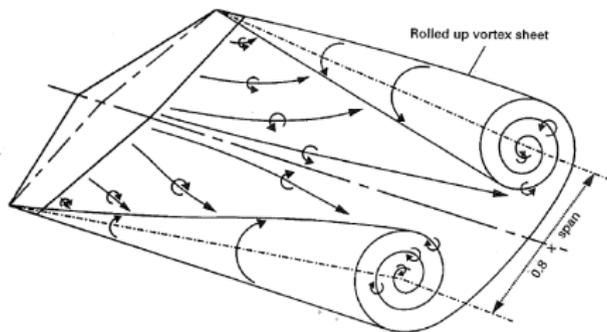


# Application Exclusion Zone

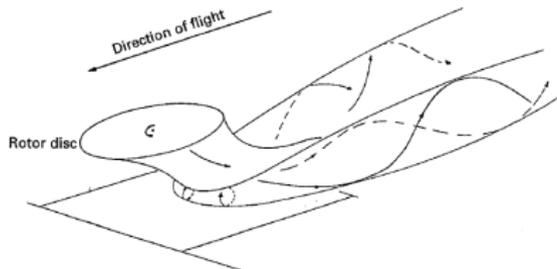


Credit: Pesticides in Forestry, A Workers' Guide to Safe Practices. Oregon Department of Agriculture, Oregon OSHA, and US EPA Region 10.

# Trailing Vortices of Fixed- and Rotary-wing Aircraft



A. Fixed-wing aircraft.



B. Rotary-wing aircraft.

Credit: Riley C, Wiesner C. 1999. Chapter 2: On-target and Off-target Deposition. Occupational Hazards of Pesticide Exposure: Sampling, Monitoring, and Measuring. p.19

# Drift Exposure Assessment Considerations: Forestry

1. Important to measure exposure in the field not just lab
2. Aerial applications
  - ▶ Can be well-controlled resulting in low drift exposure
  - ▶ Rotary-wing applications in forestry have larger droplets
  - ▶ Application technology has improved since early 2000s
3. Focus on practical solutions for pesticide safety

# Herbicide Health Considerations

1. Level of:
  - ▶ Exposure
  - ▶ Dose
  - ▶ Toxicity
2. Acute: WA State Tracking (WSDA; DOH; L&I)
3. Chronic: Ag Health Study (crop-based studies)
4. Glyphosate: IARC vs. EPA determinations
5. Dicamba: Environmental fate and transport

# Additional Resources

1. National Pesticide Information Center (NPIC)
2. Herbicide Use in Western Washington Reforestation
3. Forest Practices Application Review System (FPARS)
4. Harold Thistle's work with USFS
5. Pesticides in Forestry, A Workers' Guide to Safe Practices